

## Chemistry Unit

# Procedures for Measurement Traceability

### 1 Purpose

Measurement traceability, formally referred to as metrological traceability, is defined in the VIM (JCGM, *International vocabulary of metrology*) as “a property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty”. Measurement traceability can be characterized by the following essential elements:

- Documented unbroken chain of calibrations
- Documented measurement uncertainty (including specification of the measurand and evaluation of each step in the traceability chain)
- Documented measurement procedure
- Technical competence
- Realization of the International System of Units (SI Units)
- Documented calibration intervals
- Measurement assurance

Several of these elements (e.g., documented measurement uncertainty, documented measurement procedure, technical competence) are addressed in other FBI Laboratory and/or Chemistry Unit (CU) quality system documents.

### 2 Scope

This document applies to CU personnel recording and/or reporting measurement results that require an estimation of measurement uncertainty. These measurements are defined in the *CU Procedures for Estimating Measurement Uncertainty*. Measurement traceability is required for all measurements where measurement uncertainty is estimated.

### 3 Establishing Measurement Traceability

#### 3.1 Establishing Measurement Traceability Through the Calibration of Equipment Used

##### 3.1.1 Equipment List

The following CU equipment requires calibration when the measurement accuracy or measurement uncertainty of the equipment affects the validity of the examination and/or the calibration is required to establish metrological traceability of the examination. It is worth

noting that equipment of the type listed below that is used in CU for qualitative purposes only is not required to be calibrated.

- Balances
- Weight sets
- Pipettes
- Rockwell Hardness tester (HRB and HRC scales)
- Microhardness tester (Knoop and Vickers scales)
- Micrometers
- Calipers
- Gauge blocks
- Load cells
- Extensometers
- SmartScope

The following CU equipment does not require calibration, as the equipment calibration has been demonstrated to not be significant to the measurement result and associated measurement uncertainty:

- Volumetric glassware (e.g., volumetric flasks)

### **3.1.2 Specifications for Suppliers of External Calibration Services**

External service providers are used for the calibration of CU's equipment. Refer to *FBI Laboratory Practices for the Calibration and Maintenance of Equipment* for the specifications for suppliers of external calibration services.

### **3.1.3 Specified Requirements for Calibrations**

Suppliers of external calibration services will be considered to meet CU requirements when a calibration certificate is supplied that provides the calibration status, the specified property, its associated measurement uncertainty, and a statement of metrological traceability.

### **3.1.4 Interval of Calibration**

The calibration due date is maintained in Resource Manager in Forensic Advantage (FA) and is indicated on (or near) the equipment. The entry of a "Performance Action" in Resource Manager to update the calibration due date is how CU records that the supplier of an external calibration service and the specific calibration met the requirements in 3.1.2 and 3.1.3 above. Additional information on service providers can be found in *Chemistry Unit Procedures for the Procurement of External Products and Services*.

## 3.2 Establishing Measurement Traceability Through Reference Materials

### 3.2.1 Calibrators

Certified reference materials (CRM) with valid measurement traceability will be used as the source of calibrators when calibrators are used in conjunction with a measuring system to establish measurement traceability. If the CRM is changed in a way that alters the traceable measurement value (e.g., dilution) then calibrated equipment used to alter the CRM (e.g., pipette) will be considered part of the traceability chain.

Specific information related to preparation and evaluation of calibrators can be found in the applicable CU SOPs.

## 4 Measurement Assurance

Applicable CU SOPs contain information on the checks utilized to maintain confidence in the calibration status of the equipment and CRMs used for measurements.

## 5 Documentation

Documentation of measurement traceability relies upon a variety of records. Technical Leaders of categories of testing that require demonstration of measurement traceability will ensure the necessary records are compiled into a measurement traceability file, which may consist of paper and/or electronic records. At a minimum, this measurement traceability file will contain:

- A list of uncertainty components deemed to be significant to the measurement and how traceability of each of the uncertainty components is established (i.e., through calibration of equipment or through CRMs).
- Copies of relevant external calibration certificates, or an indication that the certificates exist and where they are located.
- Supporting documentation that demonstrates a supplier of external calibration services meets the requirements indicated in the *FBI Laboratory Practices for the Calibration and Maintenance of Equipment*, or an indication where the documentation is located.
- Supporting data and/or calculations that demonstrate calibration of particular equipment is not significant to the measurement result and associated measurement uncertainty (where applicable).
- Copies of relevant CRM certificates, or an indication that the certificates exist and where they are located.

- Supporting documentation that demonstrates a CRM provider meets the requirements indicated in the *FBI Laboratory Practices for the Calibration and Maintenance of Equipment*, or an indication where the documentation is located.

## 6 References

Joint Committee for Guides in Metrology (JCGM), *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*, 3<sup>rd</sup> ed. (Sevres, France: International Bureau of Weights and Measures [BIPM]-JCGM 200, 2012) (2008 with minor corrections).

*Chemistry Unit Quality Assurance and Operations Manual- Procedures for Estimating Measurement Uncertainty*

*Chemistry Unit Quality Assurance and Operations Manual- Procedures for Verification of Reference Materials*

*Toxicology Standard Operating Procedures Manual*

*Metallurgy Standard Operating Procedures Manual*

*Instrument Operation & Support Standard Operating Procedures Manual*

*Instrument Operation and Support System* (electronic database maintained by IOSS)

Joint Committee for Guides in Metrology (JCGM), *Evaluation of measurement data- Guide to the expression of uncertainty in measurement (GUM)* (GUM 1995 with minor corrections). (Sevres, France: International Bureau of Weights and Measures [BIPM]-JCGM 100, September 2008).

National Institute of Standards and Technology, *SOP 29 – Standard Operating Procedure for the Assignment of Uncertainty*, (Gaithersburg, Maryland, February 2012).

| Rev. # | Issue Date | History   |
|--------|------------|---|
| 2      | 09/13/19   | Deleted last sentence in section 1. Removed the specific measurements that require uncertainty from section 2 and referred to <i>CU Procedures for Estimating Measurement Uncertainty</i> document to eliminate redundancy. Edited section 3.1.1 to clarify that only equipment of the type listed that is used for significant measurements/measurement assurance requires calibration; also edited Rockwell tester, added microhardness tester, and added extensometers (removed strain gauges) to bulleted list. Clarified that ‘calibrated’ used to alter a CRM will be considered part of the traceability chain in section 3.2.1. Changed section 5 to refer to <i>FBI Laboratory Practices for the Calibration and Maintenance of Equipment</i> . Removed website addresses from references since one or more addresses had changed with time. Removed ASCLD/LAB guidance documents from references. |
| 3      | 07/15/20   | Added clarification and made minor formatting edits to bulleted list in section 1.<br>Deleted last two sentences of first paragraph in section 3.1.1 and added new last sentence addressing qualitative uses.<br>Changed “mass reference standards” to “weight sets” as these weights are not used as reference standards.<br>Changed title of section 3.1.2 and divided the content into new sections 3.1.3 and 3.1.4.<br>Deleted second paragraph from section 3.2.1 as only CRMs will be used to prepare calibrators.<br>Defined “SOP” in section 3.2.1, used in remainder of document.<br>Replaced “reference materials” with “CRMs” in section 4, and first bullet in section 5.<br>Changed wording to “supplier of external calibration services” in 3 <sup>rd</sup> bullet of section 5.<br>Deleted last bullet of section 5 as no longer applicable in CU.  |

**Approval**

Redacted - Signatures on File

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